

MATERIAL SAFETY DATA SHEET

1. SUBSTANCE AND SOURCE IDENTIFICATION

National Institute of Standards and Technology
Standard Reference Materials Program
100 Bureau Drive, Stop 2320
Gaithersburg, Maryland 20899-2320

SRM Number: 3159
MSDS Number: 3159
SRM Name: Thorium Standard Solution

Date of Issue: 16 June 2006

MSDS Coordinator: Mario J. Cellarosi
Telephone: 301-975-6776
FAX: 301-926-4751
E-mail: SRMMSDS@nist.gov

Emergency Telephone ChemTrec:
1-800-424-9300 (North America)
+1-703-527-3887 (International)

Description: This Standard Reference Material (SRM) is intended for use as a primary calibration standard for the quantitative determination of Thorium. One unit of SRM 3159 consists of 50 mL of a single element solution in a high density polyethylene bottle sealed in an aluminized bag. The solution was prepared gravimetrically from thorium oxide to contain a known mass fraction of Thorium. The solution contains nitric acid at a volume fraction of approximately 10 %.

Material Name: Thorium Standard Solution

Other Designations:

Thorium: Th; elemental thorium; thorium metal.

Thorium Nitrate: Nitric acid, thorium salt; thorium tetranitrate; thorium (IV) nitrate.

Nitric Acid: Aqua fortis; hydronitrate; azotic acid; engraver's acid.

2. COMPOSITION AND INFORMATION ON HAZARDOUS INGREDIENTS

Component	CAS Registry	EC Number (EINECS)	Concentration (%)
Nitric Acid	7697-37-2	231-714-2	10
Thorium Nitrate	13823-29-5	237-5141	2.0
Thorium	7440-29-1	231-139-7	1

EC Classification, R/S Phrases: Refer to Section 15, Regulatory Information.

3. HAZARDS IDENTIFICATION

NFPA Ratings (Scale 0-4): Health = 4 Fire = 0 Reactivity = 2

Major Health Hazards: Nitric acid can cause severe or fatal burns if inhaled, swallowed, or absorbed through the skin. Thorium compounds are radioactive; thorium nitrate is also highly toxic by ingestion or inhalation.

Physical Hazards: SRM 3159 is a limited quantity radioactive material that is exempt from radioactive labeling requirements under 49CFR section 173.421. The massic activity of SRM 3159 is less than 380 Bq/g.

Potential Health Effects

Inhalation:	Nitric acid, if inhaled, can damage the mucous membranes and respiratory tract, causing spasm, inflammation of the larynx and bronchi, chemical pneumonitis, and pulmonary edema. Symptoms may include burning sensation, coughing, wheezing, laryngitis, shortness of breath, headache, nausea, and vomiting. Inhalation of thorium or thorium nitrate dust may irritate the nose, throat, and respiratory tract. Thorium nitrate accumulates in the body and may increase the risk of cancer, birth defects, or reproductive damage.
Skin Contact:	Nitric acid can cause severe skin burns. Effects of acid burns may be delayed. Contact with thorium or thorium nitrate may cause skin irritation and dermatitis. Thorium compounds may also be absorbed through the skin, causing effects described for inhalation and ingestion.
Eye Contact:	Nitric acid can cause severe eye irritation, corneal burns, permanent eye damage, or blindness. Contact with thorium or thorium nitrate may cause eye irritation, conjunctivitis, and/or keratitis.
Ingestion:	Nitric acid can cause severe burns and damage to the GI tract. Repeated or prolonged exposure to thorium or its compounds may affect blood formation, disrupt the nervous and reticuloendothelial systems, and damage the lungs, liver, and kidneys. Thorium nitrate accumulates in the body and may increase the risk of cancer, birth defects, or reproductive damage. Metabolic reactions in the body may convert thorium and its compounds to thorium dioxide, a known carcinogen.

Medical Conditions Aggravated by Exposure: The mixture and its components may aggravate disorders of the eyes, skin, respiratory tract, and liver. Heavy drinkers and smokers may be more susceptible than others.

Listed as a Carcinogen/ Potential Carcinogen:

	Yes	No
In the National Toxicology Program (NTP) Report on Carcinogens	_____	<u> X </u>
In the International Agency for Research on Cancer (IARC) Monographs	_____	<u> X </u>
By the Occupational Safety and Health Administration (OSHA)	_____	<u> X </u>

Note: Although elemental thorium and thorium nitrate are not classified as carcinogens, both materials are mildly radioactive, and prolonged exposure may be associated with an increased risk of cancer. Thorium dioxide, a combustion product, is carcinogenic.

4. FIRST AID MEASURES

Inhalation: Move the person to fresh air immediately. If not breathing, qualified personnel may start CPR or give oxygen if necessary. Get medical aid at once, and bring the container or label.

Skin Contact: Remove contaminated clothing and shoes. Flush affected skin with water for at least 15 minutes, then wash thoroughly with soap and water. If burns are severe or if skin irritation persists, get medical aid and bring the container or label. Wash contaminated clothing before reusing.

Eye Contact: Remove contact lenses (if any). Do not allow victim to rub eyes or keep eyes closed. Flush eyes with large amounts of running water for at least 30 minutes, keeping eyelids open and raising lids to remove all chemical. Get medical aid at once, and bring the container or label.

Ingestion: Contact a poison control center immediately for instructions. Wash out mouth with water, but do not induce vomiting. Get medical aid at once, and bring the container or label.

Note to Physician (Nitric Acid): Wash affected skin with 5% solution of sodium bicarbonate (NaHCO_2). Activated charcoal is of no value. Do not give bicarbonate to neutralize the material.

5. FIRE FIGHTING MEASURES

Fire and Explosion Hazards: No data are available for this mixture, but it is not believed to be a significant fire or explosion hazard. The behavior of the solution may differ from that of the individual components. Nitric acid and thorium nitrate are oxidizers that can react with combustible materials to cause fires. Thorium metal cuttings (not present in this mixture) may ignite spontaneously if exposed to air.

Extinguishing Media: Use extinguishing media appropriate to the surrounding fire: water spray, dry chemical, carbon dioxide, or foam. A water spray may be used to cool exposed containers to prevent rupture. (These guidelines apply to the mixture; when the components are considered separately, different precautions may apply.)

Fire Fighting: Avoid inhalation of material or combustion byproducts. Wear full protective clothing and NIOSH-approved self-contained breathing apparatus (SCBA).

Flash Point (°C): N/A

Autoignition (°C): N/A

Lower Explosive Limit (LEL): N/A

Upper Explosive Limit (UEL): N/A

Flammability Class (OSHA): N/A

6. ACCIDENTAL RELEASE MEASURES

Occupational Release: Notify safety personnel of spills. Surfaces contaminated with this material should be covered with soda ash or sodium bicarbonate to neutralize the acid. Place the neutralized material into containers suitable for eventual disposal, reclamation, or destruction. Since one component of this mixture (thorium) is a radioactive material, spills must be handled and reported as radioactive waste (CFR Title 10).

Disposal: Refer to Section 13, Disposal Considerations.

7. HANDLING AND STORAGE

Storage: Store unopened containers of this material in a dry place at room temperature. Protect from physical damage, heat, and light, and isolate from incompatible materials.

Safe Handling Precautions: Wear gloves and chemical safety goggles (Section 8). Engineering controls should maintain airborne concentrations below TLV (Section 8).

8. EXPOSURE CONTROLS AND PERSONAL PROTECTION

Nitric Acid:

ACGIH TLV-TWA: 2 ppm or 5 mg/m³

OSHA TLV-TWA: 2 ppm or 5 mg/m³

Thorium Nitrate: No TLV has been established for this material. Limits for total dust, nuisance dust, or particulates not otherwise classified:

ACGIH TLV-TWA: 10 mg/m³ (inhalable particles); 3 mg/m³ (respirable particles)

OSHA TWA-PEL: 15 mg/m³ (total dust); 5 mg/m³ (respirable dust)

Thorium: No TLV has been established for this material. Limits for total dust, nuisance dust, or particulates not otherwise classified:

ACGIH TLV-TWA: 10 mg/m³ (inhalable particles); 3 mg/m³ (respirable particles)

OSHA TWA-PEL: 15 mg/m³ (total dust); 5 mg/m³ (respirable dust)

Ventilation: Use local or general exhaust to keep employee exposures below limits. Local exhaust ventilation is preferred because it can control contaminant emissions at the source, preventing dispersion into the general work area. Refer to the ACGIH document *Industrial Ventilation, a Manual of Recommended Practices*.

Respirator: If necessary, refer to the NIOSH document *Guide to the Selection and Use of Particulate Respirators Certified under 42 CFR 84* for selection and use of respirators certified by NIOSH.

Eye Protection: Use chemical safety goggles where dusting or splashing of solutions may occur. See OSHA standard (29 CFR 1910.133) or European Standard EN166. The employer should provide an emergency eye wash fountain and safety shower in the immediate work area.

Personal Protection: Wear appropriate gloves and protective clothing to prevent contact with skin.

9. PHYSICAL AND CHEMICAL PROPERTIES

Nitric Acid	Thorium Nitrate	Thorium
Appearance and Odor: Colorless to slightly yellow liquid, darkens to brown upon aging and exposure to light; irritating, pungent odor.	Appearance and Odor: Solid, white deliquescent flakes	Appearance and Odor: White, lustrous solid
Relative Molecular Weight: 63.02	Relative Molecular Weight: 480.06	Relative Molecular Weight: 232.04
Molecular Formula: HNO ₃	Molecular Formula: Th(NO ₃) ₄	Molecular Formula: Th
Specific Gravity: 1.0543 (10%)	Specific Gravity: N/A	Specific Gravity: 11.7
Solvent Solubility: Decomposes in alcohol	Solvent Solubility: Soluble in alcohol, acids	Solvent Solubility: Soluble in hydrochloric acid, sulfuric acid, nitric acid, aqua regia.
Water Solubility: Soluble	Water Solubility: Soluble	Water Solubility: Insoluble
Boiling Point (°C): 86 (187°F)	Boiling Point (°C): N/A	Boiling Point (°C): 4820 (8708°F)
Vapor Pressure (Pa): 946 @20°C	Vapor Pressure (Pa): N/A	Vapor Pressure (Pa): 1 @ 2360°C (4280°F)
Vapor Density (Air=1): 2.17	Vapor Density (Air=1): N/A	Vapor Density (Air=1): N/A
pH: 1.0 (0.1M solution)	pH: N/A	pH: N/A

NOTE: The physical and chemical data provided are for the pure components. No physical or chemical data are available for this solution of thorium and nitric acid. The actual behavior of the solution may differ from the individual components.

10. STABILITY AND REACTIVITY

Stability: ☒ Stable ☐ Unstable

Stable at normal temperatures and pressure.

Conditions to Avoid: Heat, ignition sources, and incompatible materials.

Incompatible Materials:

Nitric Acid: Incompatible with numerous materials including organic materials, plastics, rubber, chlorine, and metal ferrocyanide.

Thorium Nitrate: Incompatible with combustible materials (may ignite or explode) and reducing agents.

Thorium: Incompatible with strong acids, strong oxidizers, carbon dioxide + heat, sulfur. Thorium metal cuttings may ignite when exposed to air.

Fire/Explosion Information: See Section 5.

Hazardous Decomposition: When heated, nitric acid may produce toxic mist or vapor and nitrogen oxides (NO, NO₂, N₂O). Thorium dioxide may produce nitrogen oxides and hydrogen nitrate. Thermal decomposition of thorium and thorium compounds may also produce thorium dioxide, which is carcinogenic. Thorium also emits alpha, beta, and gamma radiation.

Hazardous Polymerization: _____ Will Occur X Will Not Occur

11. TOXICOLOGICAL INFORMATION

Route of Entry: X Inhalation X Skin X Ingestion

Nitric Acid:

Human, oral: LD_{Lo} = 430 mg/kg

Rat, oral: LD₅₀ > 90 mg/kg

Rat, inhalation: LC₅₀ (4 hrs) = 130 mg/m³

Thorium Nitrate:

Rat, intravenous: LD₅₀ = 47.6 mg/kg

Rat, intraperitoneal: LD₅₀ = 60 mg/kg

Mouse, oral: LD₅₀ = 1760 mg/kg

Thorium: In studies of laboratory animals, no deaths resulted from inhalation exposure. Oral exposure was fatal only at very high levels due to low GI absorption.

Target Organ(s): Skin, eyes, respiratory tract, GI tract, central nervous system, bones, bone marrow, lymphatic system, liver, kidneys, testes.

Mutagen/Teratogen: Nitric acid has caused birth defects in animals under experimental conditions, and has been investigated as a possible mutagen and reproductive effector. Thorium nitrate has also been investigated as a reproductive effector. Thorium and its compounds should be treated as potential mutagens.

Health Effects: See Section 3.

12. ECOLOGICAL INFORMATION

Nitric Acid, Ecotoxicity Data:

Green shore crab (*Carcinus maenas*): LC₅₀ (48 hrs) = 180,000 µg/L

Starfish (*Asterias rubens*): LC₅₀ (48 hrs) = 100,000 to 330,000 µg/L

Hooknose (*Agonus cataphractus*): LC₅₀ (48 hrs) = 100,000 to 330,000 µg/L

Brook trout (*Salvelinus fontinalis*): NR-LETH = 1,562 µg/L

Cockle (*Cerastoderma edule*): LC₅₀ (48 hrs) = 330,000 to 1,000,000 µg/L

Thorium Nitrate, Ecotoxicity Data:

Frog eggs (species not given): LOEL (growth & development, 1 month) = 0.0001%

Algae (*Scenedesmus quadricauda*): LOEL (population changes, 4 days) = 400 µg/L

Water flea (*Daphnia magna*): LOEL (immobility, 48 hrs) = 1 g/L

Thorium: No ecotoxicity data were found for elemental thorium.

Environmental Summary: This mixture and some or all of its components are toxic to aquatic organisms. Do not release to the environment.

13. DISPOSAL CONSIDERATIONS

Waste Disposal: One or more components of this mixture are a RCRA hazardous waste. Dispose of container and unused contents in accordance with federal, state, and local requirements for acid waste, which vary according to location. Thorium and its compounds must be disposed of as radioactive waste (CFR Title 10). Decontaminate containers before recycling. Processing, use, or contamination of this product may change the waste management options.

14. TRANSPORTATION INFORMATION

U.S. DOT and IATA: Nitric Acid Solution, Hazard Class 8, UN2031, Packing Group II

15. REGULATORY INFORMATION

U.S. REGULATIONS

CERCLA Sections 102a/103 (40 CFR 302.4):

Nitric Acid: RQ = 1000 lb.

Thorium Nitrate: Not regulated

Thorium: Not regulated

SARA Title III Section 302: Nitric acid is regulated

SARA Title III Section 304: Nitric acid is regulated

SARA Title III Section 313: Nitric acid and thorium nitrate (N511, Nitrate Compounds) are regulated.

OSHA Process Safety (29 CFR 1910.119): Nitric acid at higher concentrations ($\geq 94.5\%$) is regulated.

SARA Title III Sections 311/312 Hazardous Categories (40 CFR 370.21):

ACUTE: Yes

CHRONIC: Yes

FIRE: No

REACTIVE: Yes

SUDDEN RELEASE: No

STATE REGULATIONS

California Proposition 65: No components are regulated.

CANADIAN REGULATIONS

WHMIS Classification:

Nitric Acid: C (oxidizing material), D1A (very toxic material), E (corrosive material)

Thorium Nitrate: C (oxidizing material), D2A (very toxic material)

Thorium: D2B (toxic material)

WHMIS Ingredient Disclosure List: Nitric acid is regulated.

CEPA Domestic Substances List (DSL): All three components are regulated.

EUROPEAN REGULATIONS

EU/EC Classification:

Nitric Acid: O (Oxidizer), C (Corrosive)

Thorium Nitrate: O (Oxidizer), T (Toxic); not classified in Annex I of Directive 67/548/EEC.

Thorium: T (Toxic); not classified in Annex I of Directive 67/548/EEC; not on a priority list.

Risk Phrases (mixture):

R23 (toxic by inhalation)

R25 (toxic if swallowed)

R34 (causes burns)

R36/37/38 (irritating to eyes, respiratory system and skin)

R48 (dangerous of serious damage to health by prolonged exposure)

Safety Phrases (mixture):

S20/21 (when using, do not eat, drink or smoke)

S28 (wash after contact with skin)

S45 (in case of accident or illness, see doctor; show label)

S60 (dispose of this material and its container as hazardous waste)

NATIONAL INVENTORY STATUS

U.S. Inventory (TSCA): All three components are listed.

TSCA 12(b), Export Notification: No components are listed.

16. OTHER INFORMATION

Sources:

Hazardous Substances Data Bank (HSDB): Thorium Compounds.

Hazardous Substances Data Bank (HSDB): Thorium, Elemental.

Hazardous Substances Data Bank (HSDB): Thorium Nitrate.

New Jersey Department of Health, Hazardous Substance Fact Sheet: Thorium Nitrate. February 2001.

U.S. National Institute for Occupational Safety and Health, *NIOSH Pocket Guide to Chemical Hazards*, June 1990 edition. DHHS (NIOSH) Publication No. 90-117.

Disclaimer: Physical and chemical data contained in this MSDS are provided only for use as a guide in assessing the hazardous nature of the material. The MSDS was prepared carefully, using current references; however, NIST does not certify the data in the MSDS. The certified values for this material are given in the NIST Certificate of Analysis.